



The 2030 Global Agenda

Fit-For-Purpose Land Administration for Sustainable Development

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Fit-for-purpose Land Administration for Sustainable Development

The 2030 Global Agenda

INTERVIEW WITH MARK REICHARDT, OGC

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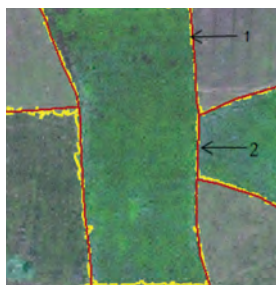
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Creating a Land Administration System that is Accepted by Local Citizens



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Towards Automated Detection of Visual Cadastral Boundaries

Initial Investigations of Imagery, Algorithms and Perceptions



All countries have to deal with the management of land. The geomatics industry provides a lot of excellent solutions for land administration. A fundamental infrastructure for the sustainable economic and social development of all societies, we thought it was about time for a themed issue on land administration.

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Opening Up Our Industry

'Location intelligence can, and indeed should, become absolutely critical – the foundation on which our business decisions are made. But for this to happen, we need to open up our industry and make it more accessible, better understood and less exclusive'. This is not something I myself wrote, but I couldn't think of a statement closer to my heart than this one. The quote comes from the AGI Foresight Report 2020 that was published in November 2015. The report gives geo-professionals good insight (and foresight) into the use of geographical information and it's still very worthwhile downloading it www.agi.org.uk/news/foresight-report. The editors of the report are completely right in their summary in which they conclude that in an era of incredible need and massive change there lies a big responsibility in the very heart of our industry to close the gap between technology (everything that is possible) and the end users (and all their requirements, wishes and questions).

I visited the Esri User Conference in San Diego last month. This yearly conference draws more than 15,000 GIS professionals to California, the majority of them coming from the United States, but also a large number from all over the world. It is indeed the biggest conference in the world focusing on geographic information and it's usage in tons

of applications. GIS professionals, sometimes not educated in geography or geomatics, are usually very skilled in using geo-information on a daily basis at municipalities and counties, other local and national governments, NGOs, insurance companies, the police, schools, etc. These are the people who determine the wishes, questions and requirements that the industry needs to answer and meet. And to be honest, at the Esri User Conference one gets the impression that the answers are pretty successful and well directed. Of course there was plenty of useful information to be obtained from the keynotes and moderated sessions and to learn in the technical training sessions. But I would especially like to highlight the Start Up Zone in the Exhibition Area where 33 companies showed how they have been integrating spatial functionality in their products. In this particular zone, CEOs, technical leads and researchers & developers interacted with professionals and delegates, presenting their products for general practitioners, architects, forestry workers, lawyers and retailers. From what I heard in this vibrant area the gap between users and technology was pretty much closed here! At another level, that of the policy makers and not the users, I would like to draw your attention once more to the UN-GGIM initiative that is in full swing. The fourth UN-GGIM High Level Forum was held at the United Nations Economic Commission for Africa Head Quarters in Addis Ababa, Ethiopia from 20 to 22 April. The theme of this High Level Forum, where ministers, state secretaries and other high-level policy makers could update themselves on the progress of UN-GGIM, was 'Good Land Governance for the 2030 Agenda'. (See a report by the UN-GGIM High Level Forum on page 36). The High Level Forum raised political awareness and highlighted importance, while also encouraging dialogue between experts and those who are responsible for deciding on the usage of these technologies in their countries. Opening up possibilities at all levels is key in making location intelligence the foundation.



▲ Durk Haarsma, publishing director

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Momentum

Every day, newspaper front pages carry headlines about injustice, disasters, conflicts, inequity, war and refugees. Updates on monitoring the progress made in achieving the Sustainable Development Goals tend to be an issue for somewhere around page 12, or even the next day's edition. The value of good land administration appears to be even further towards the back of people's minds. For most citizens and decision-makers worldwide, cadastres and registries are associated with words like 'boring' and 'bureaucracy'.

But I sense change. People are starting to analyse and better understand how things are interlinked in society. Short-term problems (our newspaper headlines) relate to mid-term solutions (Sustainable Development Goals) and long-term developments (land administration). They should now be brought into sync, making land rights for the world a conditional factor in global, national and regional development. Is something new happening in land administration? Is there momentum for change?

I believe there is – and that's not only because of my optimistic nature! It is also being underlined by upcoming initiatives. The United Nations is recognising the importance of good land administration and management by putting the issue on the agenda. The final

declaration of the UN-GGIM High Level Forum in Addis Ababa is a major step in this respect, and is commendable to read. National governments and civil communities are launching initiatives to recognise land rights for all and registering these rights both top-down and bottom-up – from Togo to Mozambique and from Cuba to Indonesia. Donor organisations and countries in the north are also taking action by relating trade and aid to people's land rights. And let's not forget the private sector. The Open Geospatial Consortium (OGC) has set up a domain group on land administration and new (and young) entrepreneurs are entering the arena, spotting business opportunities in land administration. This means that it's time to act. Land rights should be recognised and registered and used in a proper way. There's no time to lose and no money to waste.

We have a very good starting point, since much has been achieved already. The present availability technology and data is a great help. Satellite imagery, GPS and a world connected by the internet open up new opportunities that were unimaginable just a few decades ago. Standards like the Land Administration Domain Model (LADM) are helping to jump-start new initiatives and are connecting top-down and bottom-up projects together. Not only that, but the necessary knowledge and experience is in place too. The Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests (VGGT) and the recently published Guiding Principles on Fit-For-Purpose Land Administration allow for well-designed systems with respect to the legal, spatial and institutional framework.

This means we are being challenged to live up to society's expectations. And yes, there are still important issues to overcome. There is a clear need for more capacity and best practices to inspire one another. Political awareness, financing and leadership are ongoing points of concern, so there should be no loss of momentum or focus. And let me add the issue of inclusiveness. It is all about land rights for all: not only for the chosen few, not only for the elite, not only for the rich, but for everyone.



▲ Kees de Zeeuw.

Logistics Giant Invests in what3words Address System

what3words.



what3words, the multi-award-winning addressing platform, has closed a USD8.5 million Series B funding round led by global logistics giant Aramex. Existing investors Intel Capital and British funds Force Over Mass Capital and Mustard Seed also participated. Aramex operates in 60 countries around the world and will use what3words in its e-commerce fulfilment operations across the Middle East, Asia and Africa to further enhance its last-mile delivery solutions.

► <http://bit.ly/29QH1AR>

New Digital Map of Accessible Greenspace in Scotland

Ordnance Survey (OS) and the Scottish government have released an update on the project which will ultimately make it easier for people to find and access every green corner of the country's neighbourhoods, towns and cities. Building on the 2011 Scottish Greenspace Map, the new OS dataset will provide a comprehensive view of location, extent and type of recreational spaces across Scotland.

John Kimmance, OS director for public sector, said this is an exciting project, which they are pleased to be working on with the Scotland Greenspace Project Board. OS data contains a vast range of geographic features from which the boundaries and classifying all of the publicly accessible greenspaces in Scotland are identified.

► <http://bit.ly/29QswTW>



Greenspace Open extract of St. Andrews.

GISTAM 2017 Scheduled for Porto

The 3rd International Conference on Geographical Information Systems Theory, Applications and Management (GISTAM) Conference will take place from 27-28 April 2017 in Porto, Portugal. The event will be organised by the Institute for Systems and Technologies of Information, Control and Communication (INSTICC). The International Conference on Geographical Information Systems Theory, Applications and Management aims at creating a meeting point for researchers and practitioners that address new challenges in geospatial data sensing, observation, representation, processing, visualisation, sharing and managing, in all aspects concerning both information communication and technologies (ICT) as well as management information systems and knowledge-based systems. The conference welcomes original papers of either a practical or theoretical nature, presenting research or applications, of specialised or interdisciplinary nature, addressing any aspect of geographic information systems and technologies.

► <http://bit.ly/29Qsqrn>



Porto.

Innovators, Young Scholars and Storytellers Honoured with Esri Awards

Esri has acknowledged innovation and excellence in the application of geographic information system (GIS) technology with assorted geospatial awards. The accolades were presented to recipients from across globe at Esri's annual User Conference in San Diego, California, USA, on 29 June. Honours presented included the Special Achievement in GIS (SAG) Award, the Storytelling with Maps Award and the Esri Young Scholars Award. This year's winners have all demonstrated exemplary use of GIS technology to visualise geospatial data and deliver intelligence about the interconnecting relationships of their geography, Esri president Jack

Dangermond said. Through their hard work, it is possible to shine light on best practices for implementing technology to change the world. Highlighting good footprints of work conveys the recipient's insight to the entire GIS community.

► <http://bit.ly/29K40i6>



Greg Dobson showing the SAG Award.

CompassTools Launches Division for UAV-based Remote Sensing

The Compass family of businesses has introduced CompassDrone to provide airframes, software, services and support to geospatial professionals for UAS remote-sensing data collection. For industrial drone-based imagery, point cloud or IR data collection projects, CompassDrone aims to match the right airframe and software to get the results that meet aerial mapping professionals' requirements. CompassDrone is a division of CompassTools and sells DJI, Trimble and Swift Radioplanes airframes with the processing software to produce products to support the imagery professional. CompassDrone is the first industrial dealer for DJI, the world's leading drone manufacturer.

► <http://bit.ly/29Qt208>



DJI Matrice 600 UAV.

Capturing Oblique Imagery and Lidar in One Flyover

Leica Geosystems has launched Leica CityMapper as part of the RealCity 3D reality capture solution, enabling professionals to collect and process imaging and Lidar data in a single sensor. Combining CityMapper and Leica HxMap, the scalable post-processing workflow software, RealCity is designed to simplify and streamline the creation of all 2D and 3D information layers. The merging of sensors and software enables professionals to generate the most comprehensive geospatial base layer in just one flight. Professionals are able to efficiently produce all the conventional 2D and 3D information layers, from orthophotos and oblique images to point clouds, 3D meshes and 3D models.

► <http://bit.ly/2acBMRr>



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Mobile GIS Proven to Transform Land Administration

It is well understood that secure land tenure is a fundamental precondition for progress in developing economies. Typically, this is expressed with a map, but the hurdles to successful mapping and mobile data collection workflows have been difficult to overcome. Many projects have been attempted, but few have proven to be secure, easy to use, low cost, and able to evolve with changing requirements.

Last year, a rigorous test of GIS proved that Esri technology can greatly assist in building a sustainable land administration system that is incredibly easy to implement and put into use. By combining technologies and leveraging standards, geospatial mobile apps can be rapidly deployed, eliminating the obstacles that typically impede land administration progress in developing economies.

BARRIER-FREE MODEL

Those barriers are many and daunting: unreliable power supplies, intermittent or no internet connectivity, incompatibility issues, poor cell coverage, lack of trained workers—the list goes on. Realistically overcoming them requires a new model that exploits cloud services and ubiquitous low-cost technology. Esri ArcGIS Online, a platform of cloud-based map and data services, is at the center of this paradigm. It assembles the standards, devices and map services that drive efficient land administration, and it does it in simple familiar workflows that require only minimal training.

A modern land administration platform must make best use of smartphones, tablets, GNSS/GPS devices, satellite imagery, global basemaps and the cloud. When used well, all these pieces are sufficient to solve the major hardware capacity issues that many governments face. Leveraging standards, both hardware (smartphones and GPS) and software (data models), is crucial to the success of the model.

STARTING WITH STANDARDS

Standard technologies like iOS, Android and Bluetooth are part of GIS platform because Esri created simple applications that concurrently exploit the cloud while also innovating offline work. Consider the Land Administration Domain Model (LADM), now the global standard for collecting and managing land tenure data. LADM was configured and deployed on ArcGIS Online (and is also freely available on GitHub). In ArcGIS Online, the standard connects seamlessly to Android smartphones and tablets for a smooth and productive LADM field workflow.

ArcGIS Online and hundreds of preconfigured apps and resources work on these relatively inexpensive devices. They provide access to global imagery and other authoritative basemap data in ArcGIS Online. Being consumer grade, they do have challenges where higher accuracy is required, but they also have the benefit of extensibility. Standards like Bluetooth and NEMA allow users to connect a wide variety of more accurate GPS devices to Android phones and tablets and choose what accuracy fits their purpose. In the aggregate, all these standards ensure quality and ease of use in data collection workflows.

PROOF OF CONCEPT

In a recent proof of concept performed by IGAC, Colombia's national mapping agency and GPS technology company Trimble, led by Kadaster International, this lightweight GIS-based approach met all critical needs: it had to be fast to implement; based on



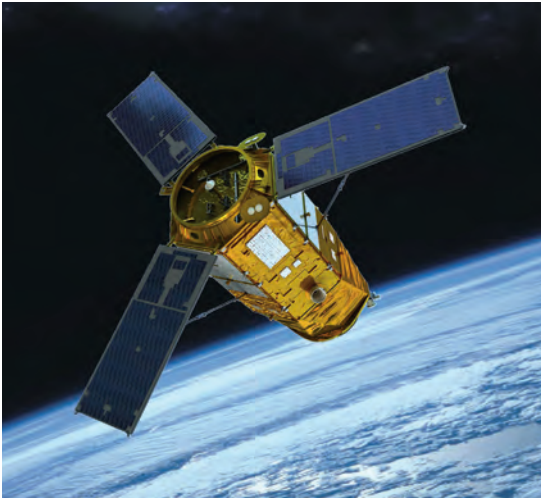
▲ Brent Jones.

standards; inexpensive; accurate; configurable (not needing customisation); secure; able to access external data, incorporate many devices, and scale to future demands; work efficiently in disconnected mode; and be easily replicable as a standard model. Mobile tools fed by ArcGIS Online data and map services met all those requirements and more, proving ArcGIS as the standard as the robust land administration platform. Read the article Light Mobile Collection Tools for Land Administration on www.gim-international.com to learn more.

A standardised lightweight GIS platform has a key advantage over other approaches: it meets all the land administration needs of the developing world, not just some. That is the essential differentiator that delivers hope for land administration worldwide.

For more information on how to modernise with lightweight GIS, visit www.esri.com/landadministration. ◀

SI Imaging Services Kicks off KOMPSAT-3A Commercial Services



KOMPSAT-3A satellite.

last year. After more than a year of successful test operations, SIIS began commercial services on 5 July. It would make South Korea the world's second country to enter the less-than-0.5-metre-resolution satellite imagery market after the United States.

► <http://bit.ly/29IC07k>

SI Imaging Services (SIIS) has started commercial services of KOMPSAT-3A imagery with the world's second highest resolution satellite on 5 July. KOMPSAT-3A is part of the Korean Multipurpose Satellite Programme developed and operated by the Korea Aerospace Research Institute (KARI) for Earth observation purposes. The Earth observation satellite offers clear imagery with a resolution less than 0.5metre. KOMPSAT-3A, also known as Arirang-3A, was launched into orbit in March

Hi-Target Opens Maintenance Centre in Czech Republic

In order to provide customers and partners in Europe with better service and faster response, Hi-Target has



Jičín, Czech Republic.

recently set up a maintenance service centre in Jičín, Czech Republic. This move has greatly improved the company's after-sales service in Europe and has made it easier for Hi-Target to acquire more information about the local market. Establishing the Jičín Maintenance Centre in the Czech Republic is a vital move as part of Hi-Target's business expansion in Europe. The Czech Republic is located in Central Europe, which puts the Jičín branch in a perfect position to cover the whole European market and cater to local service needs.

► <http://bit.ly/29RE18b>

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New Publication: Fit-for-purpose Land Administration

Guiding Principles for Country Implementation

The Global Land Tool Network (GLTN), as facilitated by UN-Habitat and in cooperation with the Netherlands' Cadastre, Land Registry and Mapping Agency (Kadaster), has launched a new publication addressing the challenge of building land administration systems in developing countries. The publication introduces a fit-for-purpose approach that allows for the systems to be built within a relatively short time frame and at affordable costs. The approach is flexible, participatory and allows for incremental improvement over time.

The publication is primarily designed to allow a range of stakeholders in developing countries to understand the overall fit-for-purpose approach and to recognise the benefits of adopting this approach.

The publication also provides structured guidance on designing the spatial, legal and institutional frameworks as the core components for country-specific implementation.

FACING THE 2030 GLOBAL AGENDA

The publication is a response to the challenges set by the overall global sustainable development agenda. This agenda cannot be achieved without having good land governance in place, including the operational component of land administration systems. The fit-for-purpose approach as presented in this publication should be seen as an enabler for implementing these global objectives in developing countries.

WHY DO WE NEED TO CHANGE CURRENT APPROACHES?

Most developing countries are struggling



▲ Oumar Sylla.

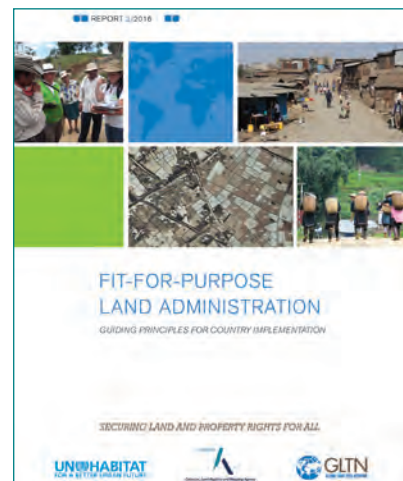
to find solutions for land issues that lead to poverty, land conflicts, natural disasters, environmental degradation, reduced investment and economic development, thus preventing the developing countries from reaching their true potential. Existing investments in land administration have been built on legacy approaches, have been fragmented and have not delivered the required pervasive changes and improvements at scale. New solutions are required that can deliver security of tenure for all, are affordable and can be quickly developed and incrementally improved over time. The fit-for-purpose approach to land administration has emerged to meet these challenging requirements.

PROVIDING SECURITY OF TENURE FOR ALL

The publication provides guidance for closing the security-of-tenure gap that exists in most developing countries – where often up to 90 percent of the land and the population are outside the formal land administration systems – and for building a sustainable land administration system which contributes to revenue generation and to reducing land-related conflicts.

FIT-FOR-PURPOSE

The fit-for-purpose concept is not just a technical fix. It is about applying the spatial, legal and institutional methodologies that are most suitable for the purpose of providing secure tenure for all by addressing the current constraints and allowing for incremental improvement over time.



▲ The publication is co-authored by Stig Enemark (Denmark), Robin McLaren (United Kingdom) and Christiaan Lemmen (The Netherlands), with support from a worldwide reference group and GLTN partners. The 120-page publication is available online from the GLTN website: www.gltn.net. We would like to take this opportunity to thank all GLTN partners who are contributing to this innovative tool.

TOWARDS A SUSTAINABLE FUTURE

It is hoped that this publication will be instrumental in paving the way towards implementing sustainable and affordable land administration systems in developing countries, enabling security of tenure for all and effectively managing land use and natural resources. This, in turn, will facilitate economic growth, social equity and environmental sustainability in line with the Sustainable Development Goals (SDGs) and Sustainable Development Indicators (SDIs). ◀

Open Standards Developed for Procurement and Implementation of Land Administration Systems

For this issue dedicated to land administration, *GIM International* interviewed Mark Reichardt, president and CEO of the Open Geospatial Consortium. He talks about the work being done by OGC and its Land Administration Domain Working Group.

How is OGC taking the initiative in the land administration domain?

As a member-driven standards development organisation, OGC members decide the domains that should have working groups formed around them. Land administration is one such domain. Earlier this year, members drafted a charter for a working group for the land administration domain. In this draft there

within OGC, but also for a huge community outside it. In order to avoid the creation of yet another set of data silos, OGC members formed the Land Administration Domain Working Group as a forum to explore and document existing interoperability standards and best practices in this domain. The group will foster coordination with other standards organisations and professional associations as

complementary open standards. Land administration activities in all countries can benefit from improved interoperability. Improved interoperability contributes to things such as reduced deployment time, lower system lifecycle costs, improved flexibility and scalability, improved choice from the IT marketplace, and improved ability to share, exchange and integrate information related to land administration.

LAND ADMINISTRATION IS A TOPIC OF GROWING RELEVANCE FOR MANY MEMBER ORGANISATIONS WITHIN OGC, BUT ALSO FOR A HUGE COMMUNITY OUTSIDE IT

is particular emphasis on the low- to middle-income countries, which is where most challenges exist today. At the OGC Technical Committee meeting in Dublin (held in June 2016, Ed.), the membership adopted the charter of the group. So it's now an official OGC Domain Working Group.

Why is this important from an OGC perspective?

Land administration is a topic of growing relevance for many member organisations

needed to share and exchange information and expertise in coordinating and advancing interoperability solutions.

What is the purpose of the group, and is there a business case driving it?

The working group's charter documents the interests of OGC members and the broader community. The charter describes how to improve the interoperability, effectiveness and efficiency of land administration systems by optimising the use of OGC and

The domain working group will examine the land administration process from the land survey organisations, up through jurisdictional levels. This will be done with partner organisations across industry, development agencies and others where necessary. The group will further work to provide a common vocabulary for the locational aspects of land administration databases, and it will also provide a forum for connecting suitable technology for data linkage and quality assessment.

How is the development of the group's goals organised?

OGC provides a forum for discussion and documentation of interoperability requirements for the land administration



▲ Mark Reichardt.

community. Generally, OGC domain working groups are composed of OGC members and experts from the broader community, with the specific intent of solving some particular interoperability problem or issue in a particular technology domain.

For example, during our March OGC Technical Committee meeting hosted by the World Bank, we saw presentations about, and received input on, the Fit-For-Purpose Land Administration Guide[3], which is based on the use of imagery for cadastral data collection, as well as on the Social Tenure Domain Model[4] (STDm), which, among other things, uses LADM[5] and the OGC GeoPackage standard[6].

OGC members will prepare and deliver informational presentations at our regular meetings, and they will discuss the market use and adoption of OGC standards as they relate to land administration. The Land Administration Domain Working Group (DWG) will be open to OGC members and also the public by default, including access to the domain working group via email lists and working group meetings. If it is found that requirements of this group cannot be satisfied by the current OGC standards, the forum can

Worldwide, effective and efficient land administration is an ongoing concern in many countries, and less than 30% of Earth's land is properly titled or surveyed. Only a small number of nations worldwide have mature land information systems, and only a fraction of those remaining have some land administration capability in place. Others are non-existent, or are manual, paper-based systems subject to limited public access and a significant risk of data loss due to disasters. A poorly implemented or paper-based land administration system leads to insecurity of tenure, economic barriers and land grabbing, and causes major problems when resolving land conflicts.

Land administration frameworks are challenging to develop because they have to support a wide variety of regulatory and policy environments. Furthermore, interoperability between underlying technologies and systems is key in providing the necessary flexibility. There is an impetus to guide developing nations in a programmatic way to establish cost-effective, interoperable land-administration capability, to upgrade current manual processes and to field automated solutions that are can be flexibly adapted to new data sources and new technologies. Key is the ability of proposed land administration frameworks to support the regulatory and policy environments that are often unique to individual jurisdictions and nations.

As such, the Open Geospatial Consortium (OGC) has formed a Land Administration Domain Working Group [1] to better face these challenges. The OGC Land Administration Domain Working Group Charter [2] specifies the objectives of the group.

develop Change Request Proposals and submit them to the respective working group, which will evaluate the proposed changes.

ISO and FIG have already developed the land administration domain model, known as the LADM – is this linked to developments within OGC?

Yes, absolutely. OGC has standing liaisons with major players in the land administration domain, including Technical Committee 211 of the ISO (this committee of the International Standardisation Organisation is on geographic information, Ed.), the Royal Institute of Chartered Surveyors, the World Wide Web Consortium, OASIS, the International



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Federation of Surveyors, and the Global Land Tool Network. OGC always strives to use, build on and complement existing standards. However, while there are some standards describing elements of an administrative system, such as in LADM, there might be

Is there a time frame for this DWG?

OGC DWGs don't work to set time frames, as they are designed to stimulate discussion, identify challenges and refer them to appropriate Standards Working Groups (SWGs) and/or partner organisations. OGC

when the membership can no longer see any issues that require discussion.

How will the world benefit from this?

The broader software industry, open-source software developers and service providers will get a better understanding of the technical interoperability needs of the land administration domain. Land administration users will gain a better understanding of the existing technical standards in the geospatial domain and how they can be leveraged to help them solve their problems. If the Land Administration Domain Working Group is successful then, in the long run, users will be able to look to the outcomes of the DWG and find open standards specifically developed for procurement and implementation of land administration systems. ◀

THERE ARE NO ADEQUATE RULES FOR DEFINING AND DESCRIBING THE QUALITY OF LAND RECORDS

gaps in the way that they incorporate geospatial descriptions of land records, and/or inadequate rules for defining and describing the quality of the records. The Land Administration DWG aims to assess the existing standards and address any gaps it finds.

Who will join the Land Administration Domain Working Group?

The DWG is open to anyone interested in the topic. We hope to see a vivid dialogue between the geospatial and the broader land administration community. For specific events, guests can be invited to present on a specific topic that may not be represented by the working group members.

What about the United Nations and the World Bank? How do they fit into the DWG?

The United Nations and the World Bank are members of OGC. They played an important role in raising the interest in land administration activities among our membership and in the first ad hoc meetings. They continue to take a leading role in defining requirements and connecting with other players in this domain.

Are there options for involvement of developing countries?

Yes, certainly. As I indicated, any interested players can join the Land Administration Domain Working Group, and can become members of OGC and participate in other OGC working groups. OGC offers special rates and opportunities for low-income countries and is very interested in supporting development and capacity-building in these regions. With that in mind, Athina Trakas, our OGC European Services Director, has recently extended her responsibilities for member services specifically for the Central Asian and African regions.

staff facilitate the meetings of the group at the regular OGC Technical Committee meetings, which take place four times a year in different regions of the world. OGC DWGs will 'sunset'

About OGC

The Open Geospatial Consortium (OGC) is an international consortium of more than 530 companies, government agencies, research organisations and universities participating in a consensus process to develop publicly available geospatial standards. OGC standards support interoperable solutions that 'geo-enable' the internet, wireless and location-based services and mainstream IT. OGC standards empower technology developers to make geospatial information and services accessible and useful with any application that needs to be geospatially enabled.

Visit the OGC website at www.opengeospatial.org.

Mark Reichardt



Mark Reichardt is president and chief executive officer of the Open Geospatial Consortium. He has overall responsibility for consortium operations, overseeing the development and promotion of OGC standards and working to ensure that OGC programmes foster member success. Mark also works with other standards development organisations and professional associations to establish alliance agreements, which ensure that OGC standards and other standards work together fluidly. Such coordination is critical, for example, to support standards and community coordination, allowing the integration and use of geospatial information in other domains such as the land administration and land information communities.

References:

- [1] <http://www.opengeospatial.org/projects/groups/wg>
- [2] <https://portal.opengeospatial.org/files/68353>
- [3] <https://www.fig.net/resources/publications/figpub/pub60/Figpub60.pdf>
- [4] <http://www.stdm.gltm.net/>
- [5] http://www.iso.org/iso/catalogue_detail.htm?csnumber=51206
- [6] <http://www.geopackage.org/>

Fit-for-purpose Land Administration for Sustainable Development

Sound land governance is fundamental to achieving the 2030 Global Agenda as set by the Sustainable Development Goals (SDGs) adopted by all the world's leaders at the UN Summit in September 2015. This Global Agenda calls for a "data revolution" for sustainable development to empower people with information on the progress towards meeting the targets.

Good land governance and administration should be seen as a means to support the Global Agenda 2030. Land governance is about the policies, processes and institutions by which land, property and natural resources are managed. The organisational structures for land governance and administration differ widely between countries

and regions throughout the world and reflect the cultural and judicial setting of the country and jurisdiction. Land administration systems provide a country with an infrastructure for implementing land policies and land management strategies in support of sustainable development. The operational component of the land governance concept

is the range of land administration functions that include the areas of: land tenure (securing and transferring rights in land and natural resources); land value (valuation and taxation of land and properties); land use (planning and control of the use of land and natural resources); and land development (implementing utilities, infrastructure,



▲ Figure 1, The Sustainable Development Goals. Goals 1, 2, 5, 11, 15 and 16 are land related.

construction works and urban and rural developments).

THE SDGS

The SDGs include six goals with a significant land component mentioned in the targets. For example, Goal 1 calls for ending poverty in all its forms everywhere, and target 4 of that goal states that by 2030 all men and women will have equal rights to ownership and control over land and other forms of property. Similarly, the land component is referred to in target 3 of Goal 2 on ending hunger and, more generally, in Goal 5 on gender equity, Goal 11 on sustainable cities, Goal 15 on life on land, and Goal 16 on peace, justice and strong institutions. These goals and targets will never be achieved without having good land governance and well-functioning countrywide land administration systems in place (see Figure 1).

MONITORING

There is a strong requirement for effective monitoring and assessment of progress towards achieving the SDGs. There is a need for reliable and robust data for devising appropriate policies and interventions for the achievement of the SDGs and for holding governments and the international community accountable. Such a monitoring framework is crucial for encouraging progress and enabling achievements at national, regional and global level. This calls for a 'data revolution' for sustainable development to empower people with information on the progress towards meeting the SDG targets. The World Bank, in conjunction with the United Nations (UN) and other partners, has developed the Land Governance Assessment Framework (LGAF) for benchmarking and monitoring the core areas, such as the legal and institutional frameworks. The wider Global Agenda includes a range of land-related issues as briefly presented below and illustrated (Figure 2).

LAND TENURE

Responsible governance of tenure is now incorporated as part of the Global



▲ Figure 2, The wider Global Agenda includes a range of land-related issues.

Agenda through the Committee on World Food Security's Voluntary Guidelines on Responsible Governance of Tenure (VGGT). The guidelines are an international 'soft law instrument' that represents a global consensus on internationally accepted principles and standards for responsible practices.

The United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) is mandated, among other tasks, to provide a platform for the development of effective strategies on how to build and strengthen national capacity on geospatial information and disseminating best practices. UN-GGIM has included land administration activities in its remit of global information management. UN-GGIM is gaining influence in the geospatial domain, e.g. geodetic framework, and providing guidance to the geospatial user community. UN-Habitat has developed an innovative approach to addressing the land tenure issue through the Social Tenure Domain Model (STDM). This includes a 'scaling-up approach' with a range of steps from informal to more formalised land

rights. This continuum of land rights does not mean that societies will necessarily develop into freehold tenure systems, but rather that each step in the process can be formalised, providing stronger protection than at earlier stages. This ensures that legitimate rights, such as customary tenure, are recognised.

HUMAN RIGHTS

The Universal Declaration of Human Rights states the universal rights of human beings based on the principle of respect for the individual. In relation to land and governance, the declaration states that "everyone has the right to possess property (security of tenure) and the right to adequate food, clothing and housing". The right to housing should be seen as the right to live somewhere in security, peace and dignity. Women's access to land needs first and foremost to be seen as a universal human right, independently of any other arguments in favour of it. Human rights are fundamental and should be encouraged and promoted through building adequate land administration systems that are relevant and accessible for poor people.

MY TOUCH SOLVING LAND PROBLEMS



PETER FOSUDO,
MASTER'S STUDENT GEO-INFORMATION SCIENCE AND EARTH OBSERVATION AT ITC

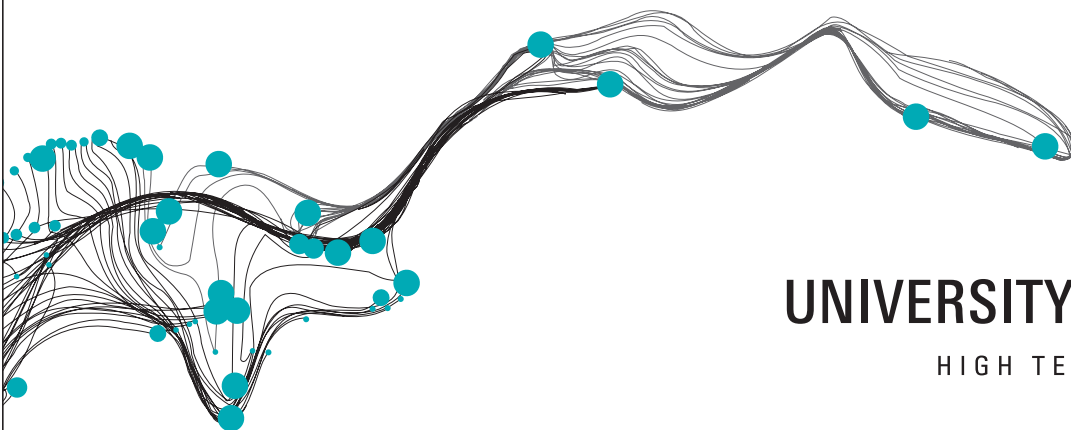
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HIGH TECH HUMAN TOUCH

CLIMATE AND DISASTERS

One of the elements in achieving climate-resilient urban development and sustainable rural land use is the degree to which climate change adaptation and risk management are mainstreamed into two major components of land governance, namely 1) securing and safeguarding land rights, and 2) planning and control of land use. In this regard, responsible land governance should be underpinned by fit-for-purpose (FFP) land administration systems that include security of tenure rights as well as effective land-use planning and control.

URBANISATION

Urbanisation is a major change that is taking place globally. By 2030, 60% of the world's population is expected to be urbanised. This incredibly rapid growth of megacities is causing severe ecological, economical and social problems, and it is increasingly difficult to manage this growth in a sustainable way. It is recognised that over 70% of the growth currently happens outside of the formal planning process and that 30% of urban populations in less developed countries are living in slums or informal settlements, i.e. where vacant state-owned or private land is occupied illegally and used for slum dwellings.

LAND PROFESSIONALS

Solutions to the overall global land issues relate to alleviation of poverty, social inclusion and stability, investments and economic development, and environmental protection and natural resource management. These land matters are now embedded in the SDGs, and the land professionals are the custodians of the systems dealing with these land issues. The lawyers have a major role to play in land administration by setting the legal and regulatory frameworks and delivering land administration services in countries where the judicial system supports land registration. Land surveyors normally enjoy a monopoly on boundary determination within their countries, but in the majority of developing countries there are simply not enough surveyors to meet demand.

FIT-FOR-PURPOSE APPROACH

Existing investments in land administration and management solutions have been piecemeal and have not delivered the required changes

and improvements at scale. The solutions have not helped the most needy: the poor and disadvantaged with no security of tenure. In fact, the beneficiaries of this unsustainable management of land have been the rich, elite and organisations involved in land grabbing. Current solutions are not effective within developing countries and it is time to rethink the approaches. Solutions are required that can deliver security of tenure for all, can be quickly developed and are scalable. Such a solution is offered by the recent GLTN publication on Fit-For-Purpose Land Administration – Guiding Principles for Country Implementation (see announcement on page 11 of this edition of GIM International). This publication outlines a pragmatic and realistic fit-for-purpose (FFP) approach for developing countries that can provide security of tenure for all across a country within a generation based on the requirements from the Global Agenda. This brave new thinking has evolved out of successful, innovative projects in Rwanda, Ethiopia and Kyrgyzstan, for example. Strong political leadership and land professionals willing to adopt serious change have underpinned these successful projects. The publication presents the concept, provides the connected key principles and a generic set of guidelines to be applied in developing a country-specific FFP strategy for land administration.

OPPORTUNITIES

The hearts and minds of land professionals need to be touched if they are to fully understand and embrace the FFP approach. This will require the benefits of such a move to be clearly articulated so that any perceived threats are dissipated. The FFP approach will create even greater demand for land professionals as security of tenure is provided for all, and the need for services will increase significantly. For example, new services will be required to upgrade the evidence of land rights along the continuum of rights, to provide training and supervision of local land officers and to effectively manage and ensure the quality of land information. This is a great opportunity for land professionals. Organisations such as FIG and their member associations need to actively promote the adoption of the FFP approach to land administration among their membership and to enable experiences and best practices to be shared between land professionals.

CONCLUDING REMARKS

There is a general consensus that governing the people-to-land relationship is at the heart of the Global Agenda. There is an urgent need to build simple and basic systems using a flexible and affordable approach to identify the way land is occupied and used by all, whether these land rights are legal or locally legitimate. To meet the actual needs in society today, the systems need to be flexible in terms of the legal regulations as well as the institutional arrangements.

When considering the resources and capacities required for building such systems and the connected basic spatial framework in developing countries, the conventional Western-style concepts may well be seen as the end target but not as the point of entry. During the assessment of technology and investment choices, the focus should be on a fit-for-purpose approach that will meet the current societal needs and can be incrementally improved over time. Building such spatial, legal and institutional frameworks will establish the link between people and land. This will enable the management and monitoring of improvements in meeting the aims and objectives of adopted land policies as well as achieving the goals and targets of the Global Agenda. Land professionals have a key role to play in this regard. ◀

FURTHER READING

Stig Enemark (2016): *Facing the Post-2015 Global Agenda: The Role of Land Governance and Land Professionals*. FIG Working Week, Christchurch, New Zealand, 2-6 May 2016.
Stig Enemark (2013): *Fit-for-purpose Land Administration*. *GIM International*, July 2013, 26-29.

STIG ENEMARK

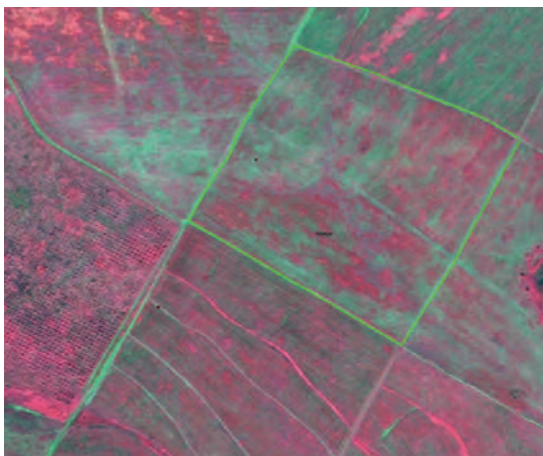


Stig Enemark is honorary president of the International Federation of Surveyors (FIG) and was president from 2007-2010. He is professor of land management at Aalborg University, Denmark. He is a well-known international expert in the areas of land administration systems, land management and spatial planning, and related educational and capacity-building issues, and has published widely in these areas.
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Enabling Global Land Tenure Security Using High-resolution Imagery



▲ Figure 1, 50cm imagery mosaic of South Africa.



▲ Figure 2, Mapping agricultural land boundaries in Ethiopia from satellite imagery.

Traditional techniques for developing land administration include high-accuracy field-based surveying of the property boundaries by certified surveyors, and may be still a desired solution for cadastral mapping in residential urban areas. The recent decade has seen a rise in high-detail and high-accuracy satellite imagery that is now able to capture large regions and update them on a periodic basis.

DigitalGlobe, a commercial leader in the satellite remote sensing industry, has been capturing images at 50cm resolution for the last decade. The latest generation of its Worldview systems are now collecting imagery at 30cm (1ft) spatial resolution. Furthermore, the company has now invested in developing accurate and high-quality mosaics of nations that can become the foundation for developing the global cadastre or land administration system (see Figure 1). In countries such as the USA, it is already an acceptable practice to use imagery as a reference for creating urban parcels.

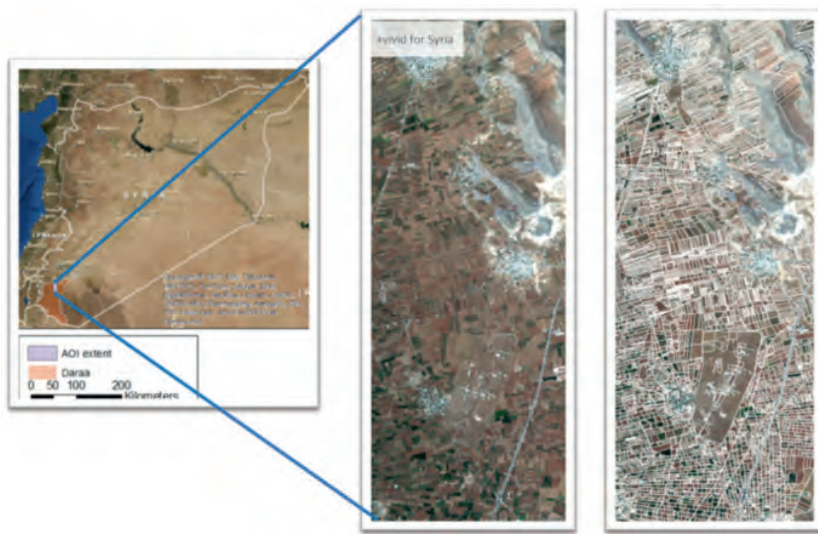
STATUS OF CADASTRE

It is estimated that over 70% of the world's population do not have formal documentation of their land ownership. In developing countries in Asia and Africa, this problem is further exacerbated by inequality in land ownership between men and women. Furthermore, in many of these nations, which have a rich heritage dating back many centuries, land information/ownership records have been passed down through

the generations and are not defensible in court. A comprehensive digital and geospatial land administration for the entire country is a requisite for these developing nations. In the case of contested lands, there is a need to build consensus at village level to create a land administration system that is accepted by local citizens.

USE OF IMAGERY

Imagery at 50cm resolution covering the entire nation allows for faster and more economical creation of a nationwide land administration system, with a proper representation of spatial units (or parcels). It is suitable for the establishment of land administration in agricultural areas – farms, pastures, etc. (see Figure 2) – and forest areas. For example, the United States Department of Agriculture (USDA) has developed a comprehensive database of agricultural field boundaries (Common Land Unit) for the whole of the USA based on imagery. Depending on the requirements, imagery can also be used in residential areas (see Figure 4).



▲ Figure 3, Agriculture parcels digitized from country mosaic in Syria



▲ Figure 4, Imagery used as reference in urban parcel creation in Harris County, Texas, USA.

COMPLETE BY YEAR END

DigitalGlobe already provides accurate and complete imagery mosaics of nations at 50cm for the entire continent of Africa as well as for two thirds of the whole world. The rest of the world mosaic is anticipated to be completed by the end of 2016. Each mosaic comes with comprehensive metadata at pixel level, on the age of the imagery as well as aggregated statistics at national level on missing/no-data pixels as well as cloud cover. The example shows a 98% cloud-free mosaic of South Africa which is now being updated to make it 100% cloud free, for the entire nation.

DATA MAINTENANCE

National imagery mosaics from DigitalGlobe can be used not only as the foundation for the cadastral maps in national land administration systems, but also to update them on an ongoing basis. It is also important to keep in mind that the cadastral maps need to consider spatial consistency from multiple sources of imagery with varying accuracies. Figure 5 shows an example of spatial registration issues (in yellow)

over time, stemming from using multiple imagery sources. While vector alignment and conflation techniques are now available to correct for legacy spatial registration issues, it is paramount to consider the update and maintenance of land administration systems for decades to come.

Imagery mosaics are available for both online and offline use and can be integrated with field tools that allow for field digitisation of land parcels. The imagery maps can also be printed in the field, so that local villagers can draw their land ownership on them, and can later be scanned and converted into a land parcel database. Field tablets that can integrate imagery and have tools for field coordination and consensus are vital for creation and adoption of successful national land administration systems.

CONCLUDING REMARKS

High-accuracy and high-detailed satellite imagery mosaics combined with latest technological developments including smartphones, tablets and suchlike allow global land cadastres to be created at scale (see Figure

6). These technologies facilitate rapid creation, maintenance and updates of land administration as well as incorporation of legacy cadastre/ records. In combination with additional visual information, printed maps can be used to build consensus at village level in support of gaining acceptance of the land administration system at national/state and local levels. ◀



▲ Figure 5, Vector conflation techniques can help correct legacy land records.



▲ Figure 6, Tablets with imagery and digitisation tools can aid in land registry development.

KUMAR NAVULUR

Kumar Navulur has over 25 years experience in geospatial industry. He received his PhD from Purdue University, USA. He is part of UN-GGIM which advises various international governments on the use of geospatial technologies for governance. He advised the Norwegian mapping authority on use of satellite technologies for their 2025 Destination Mapping project. Also he is a recognised geospatial expert at World Bank, Bill and Melinda Gates Foundation, and other international organisations and governments.

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INITIAL INVESTIGATIONS OF IMAGERY, ALGORITHMS AND PERCEPTIONS

Towards Automated Detection of Visual Cadastral Boundaries

The technology push behind emerging automated feature identification and line generation techniques provides a new opportunity for the domain of fit-for-purpose land administration. It could help to further automate the process of boundary generation in cadastral systems – particularly in contexts where large areas remain unmapped and cadastral boundaries align with topographic or visual boundaries.

Fit-for-purpose land administration aims to align cadastral policies, administration and technology selection with the prevailing societal needs and capacity within a country context. It seeks to aid delivery of more rapid and low-cost cadastral boundary mapping in support of widespread land tenure security. The mindset promotes high-resolution satellite images (HRSI) as an initial source

for creating cadastral boundary information. Efforts are now focusing on whether emerging automatic boundary detection techniques can further expedite the process.

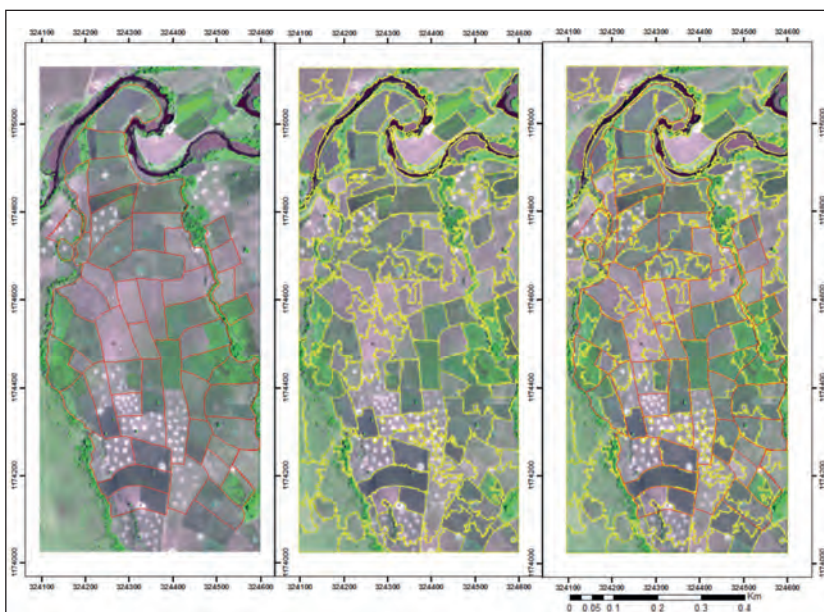
THE FIRST WAVE

The first wave of fit-for-purpose implementations – see Rwanda, amongst others – made extensive use of imagery

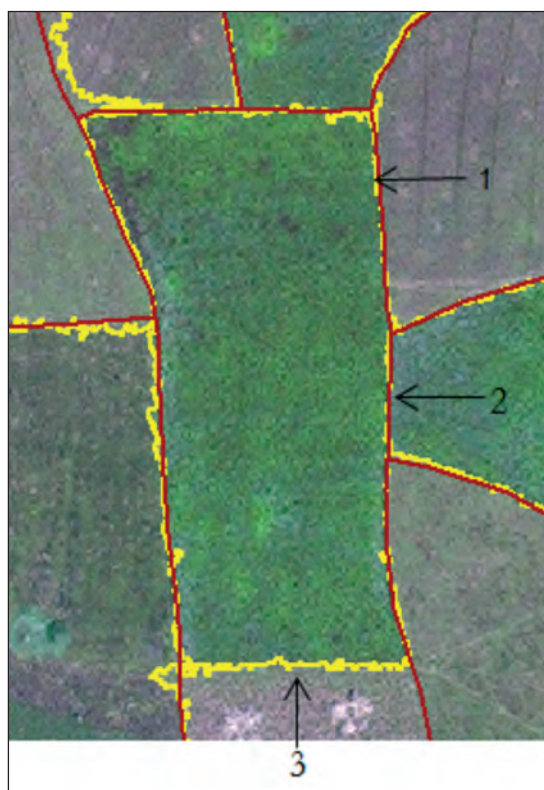
and paper-based procedures. The use of HRSI for interpreting parcel boundaries presented a rapid method that did not require professionals to undertake the fieldwork. Large numbers of parcels could be mapped – and then registered – in less time and with lower costs than before. Compared with conventional methods, the use of HRSI is estimated to cost just one-third for rural areas and one-fifth for urban areas. It is ideal in contexts where large parts of the jurisdiction remain unmapped and only limited numbers of land professionals are available.

ENTER AUTOMATION

Even though the fit-for-purpose approach has been shown to work, it is still intensive in terms of labour, processes and logistics – and therein lies the opportunity to further reduce the costs and time involved. One way is to use emerging techniques for automatically extracting features from imagery and apply them in cadastral mapping. In other words, where there is a high degree of alignment between visible boundaries and cadastral boundaries, software can be used to automatically generate an estimated parcel fabric. This means a ‘first go’ cadastral map, overlaid on imagery, can be created automatically in the office, taken into the field and then edited by communities, rather than being produced and digitised from scratch. The savings are suggested



▲ Figure 1, Reference shape file overlaid on subset image1 (left), extracted provisional boundaries overlaid on subset image1 (middle) and both reference and extracted shape files overlaid on subset image1 (right)

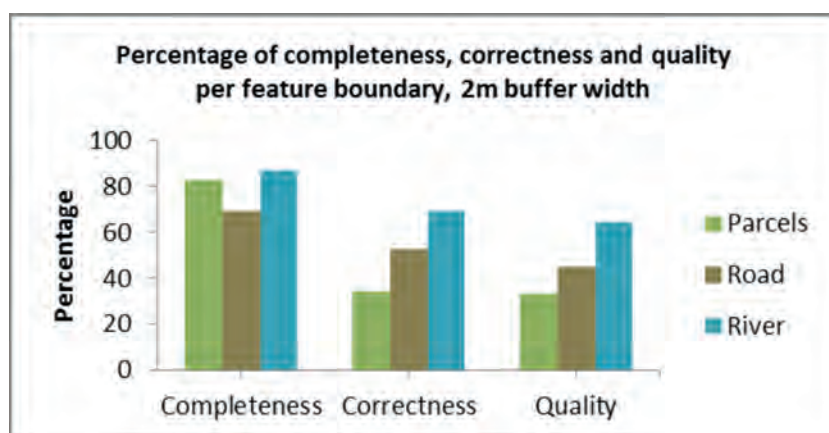


▲ Figure 2, Reference and extracted boundaries overlaid together.

to be considerable, but the workflow relies on the quickly generated 'first go' being of sufficiently high spatial quality in order to keep the editing time low.

PROOF OF CONCEPT

To assess the viability of the concept, a semi-automated workflow was developed and tested. The workflow was based around the use of a mean-shift segmentation application plug-in in QGIS. A case location was selected in the Amhara region of Ethiopia. The location was regarded as an 'easier' case for trialling the concept. It consisted of a rural area with subsistence agricultural land use and was considered representative of many other smallholder areas in parts of Ethiopia specifically and Sub-Saharan Africa more generally. Various features represent cadastral boundaries: water bodies, bushes and parcels covered by bare soil and grasses. WorldView-2 satellite images were acquired for the test areas. The parameters used to extract these boundaries were determined by trial and error. Importantly, an existing cadastral parcel fabric dataset was already available for the area. The data was used as



▲ Figure 3, Percentage of completeness, correctness, and quality per cadastral feature boundaries

control and enabled comparison of the semi-automated machine-generated cadastral data.

IMAGES AND OUTPUTS

The imagery and outputs can be seen in Figure 1, which shows the automatically extracted boundaries (right-hand side) and the reference boundaries (left-hand side). The relationship between extracted boundaries, reference boundaries and the land cover information can also be seen. For the reference image (left), the reference boundaries lie between parcels that tend to have differences in brightness and colour. However, there are also parcels containing two different plots; a colour difference and subsequent false parcel identification is evident. The middle image reveals that the applied technique enables boundaries between parcels to be extracted based on colour and brightness. The segments formed are polygons; they are non-overlapping and there are no gaps between them. Due to brightness and/or colour differences along pixels, and the effect of haystacks and bushes, false boundaries are also observed. The third image provides more information about the capability of the algorithm to extract cadastral boundaries; some cadastral boundaries almost perfectly overlapped with the extracted boundaries. In the case of a different colour for the land cover near the boundaries, the extracted boundaries matched with reference boundaries (Figure 2). For a comparative view of qualities of the extracted boundaries – against the reference boundaries – the percentage of completeness, correctness and qualities of

parcel boundaries, road boundary and river boundary were compiled (Figure 3).

PROFESSIONALS' VIEWS

During interviews, land administration professionals shared their experiences with the current land registration approach employed in Ethiopia and on the nature of cadastral boundaries in rural areas. They explained that techniques based on orthophotos, total stations and GPS are being used in the Amhara region (and satellite images are being used in other regions). Ongoing challenges are errors from the first registration, time and cost issues, and a lack of skilled manpower. With respect to the visibility of cadastral boundaries from HRSI, they also explained that – except for a few cases – rural boundaries in general are visible from HRSI. The issue of non-visible boundaries was one of their concerns, although not of this study. It was suggested that in rural areas roughly one in five parcels have a visibility problem. It was indicated that if it were possible to achieve even 40% or 50% by extraction methods, the 'missed' boundaries could be fixed by other methods. It was suggested that the time needed for editing automatically extracted boundaries would be much shorter than for digitising from scratch. However, all interviewees underlined the importance of field verification to successfully implement the automatic approach. The benefit of this method during difficult weather conditions is another advantage over conventional methods.

LOOKING AHEAD

In general, the mean-shift segmentation can

be implemented on both multispectral and panchromatic images to produce vector files ready to be used in a GIS environment. The method can also capture arbitrarily shaped boundaries and produce closed polygons mainly in non-vegetated and flat terrain. The results obtained are vector files satisfying many cadastral boundary requirements and are ready to be used in a GIS environment. The results suggested that the method worked well for river boundary extraction, road boundary extraction and for boundaries of parcels in relatively open and flat terrain (showing brightness/colour difference around boundaries of parcels). For vegetated areas and for areas with non-visible cadastral boundaries, however, the use of other methods is more advisable. Moreover, more robust comparisons of cost, time and quality – against conventional methods – are needed. Procedures for field verification would also need to be developed. ◀

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FIT-FOR-PURPOSE APPROACHES ARE POSSIBLE BASED ON INSAR TECHNOLOGIES

Airborne Dual-band Radar for Cadastre

The issues of land ownership and land use rights are high on the Global Agenda 2030. 50% of the Sustainable Development Goals are land related. A very rough estimation for reaching these goals with traditional cadastral data acquisition approaches amounts to over 500 years of cadastral survey work. This estimation clearly illustrates that breakthrough techniques will be necessary to meet the targets.

A well-known approach for surveying large areas in a short space of time is airborne or space-borne remote sensing. In fit-for-purpose approaches for land administration, printed imagery is used in the field for boundary identification in a participatory way. But can radar image data support the mapping of cadastral boundaries in an efficient way? A promising new approach in this area is using airborne dual-band (X-band and P-band) Interferometric Synthetic Aperture Radar (InSAR). Due to the known advantages, such as cloud penetration, sunlight independency and foliage penetration, radar imagery has increasingly been used for large-scale mapping and monitoring over the last decade.

TECHNOLOGY

Bradar's airborne dual-band radar uses the X and P bands because they have the most complementary mapping characteristics. While the X band, with 3cm wavelength, maps the visible surface only, the P band, with 70cm wavelength, penetrates the foliage and allows the topography beneath the vegetation to be mapped. In the past, the main application of this technology was in interferometric phase processing for topographic mapping. Nowadays, the high-quality images from the amplitudes are opening up new horizons for planimetric feature extraction in scales up to 1:5,000, with the major advantage of cloud penetration and a wide mapping swath. The airborne radar system mentioned above combines all these characteristics and has already mapped an area of approximately 2.3 million square kilometres in Central & South America and Europe (see Figure 1).

DETECTING FENCES

New studies performed by Bradar in Brazil have shown that the P band is not only capable of detecting boundaries demarcated by roads, rivers or vegetation, but also of detecting very fine wire fences which are commonly used in South America for demarcating land (see Figure 2).

Applying this technology to support land registration and cadastral survey could be the solution for speeding up registration processes and helping to protect local populations against land grabbing.

SURPRISING RESULTS

Tests showed that the feature extraction of these fences can be realised with a high planimetric accuracy of up to 20cm in the P-band imagery (see Figure 3), which meets the requirements for supporting land administration in many developing countries. This surprising result can be achieved because the horizontal wires of the fences



▲ Figure 1, Left BradarSAR, right OrbiSAR.



▲ Figure 2, Wire fence constructions are very often cadastral boundaries. Those fences can be easily detected with P band radar imagery.

act like small antennas for the horizontally polarised P-band radiation. Since the fences are close to the ground, one can observe the so-called double-bounce effect of the wave back to the radar. Due to this effect the signals from all the horizontal wires of the fence combine into a sum total, and the fence appears in the image as a single line in the position of its vertical projection on the ground. Figure 4 shows an example of a P-band image with a fence network in a deforested area. In addition to the fences, other important features can be extracted such as woodland, roads, buildings, single trees and animals.

APPLICATIONS

The radar imagery can be applied for integral cadastral boundary detection. Most of those boundaries are visible features, defined by roads, vegetation, rivers, fences and buildings in a very efficient way. Even rivers concealed by vegetation can be extracted. Figure 5 shows an example of an area in Brazil, including orthoimages X, P, X/P colour, and extracted boundaries overlaid on the P-band image (from left to right). Additionally, digital terrain models and/or surface models can be provided by applying interferometric flights to obtain altimetric information for generation of contour lines and extraction of drainage networks, including 3D simulations. This information is useful in support of not only land administration but also rural development, infrastructure projects, forest certification, rural environmental cadastre, risk mapping, area preservation, land use mapping and topographic mapping, among many other applications.

CHANGE DETECTION

The radar imagery has another big advantage for change detection, namely the repeatability of illumination geometry between different

flights. As opposed to optical images, this allows a systematic comparison of the images supported by image processing software. Changes in land use can be detected automatically in any type of construction. This provides the option to reconstruct 'replaced' cadastral boundaries.

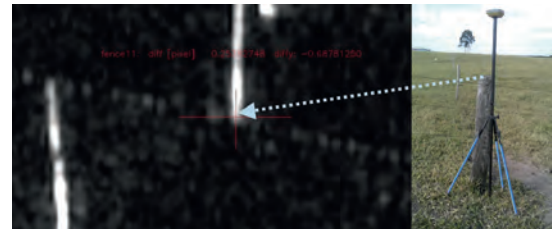
EXPERIENCES IN BRAZIL

The applicability of this approach has already been demonstrated in two technical feasibility studies: one close to the hydropower station of Belo Monte and the other in the district of São José dos Campos. Planimetric accuracy was measured with differential GPS at both sites. Wire fences presented an RMSE error of around 20cm and water boundaries of around 1m.

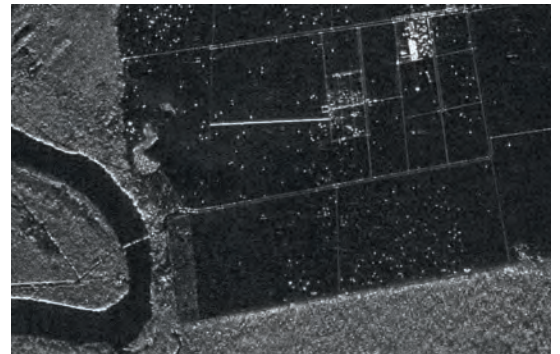
The radar survey will not completely replace ground survey, but it allows the ground boundaries to be generally defined and vectorised before going out into the field. In Brazil, for example, the interview with the landowner, the review of land boundaries and the demarcating must be carried out as a ground survey. Using radar imagery could reduce the amount of effort and time involved in conventional fieldwork by a magnitude of three to five.

FIT-FOR-PURPOSE APPROACHES

Agencies in Brazil and Latin America had not previously considered remote sensing for land administration development, and current governmental regulations do not even allow it without performing a complete ground survey. Radar surveying can speed up such a ground survey and serve as a control method. In fit-for-purpose approaches, radar imagery is now being considered as an effective way of collecting cadastral boundary data quickly and cheaply. Printed imagery can be taken into the field to compare automatically



▲ Figure 3, Planimetric accuracy for fence detection in P band imagery – the fence can be projected to the surface of the earth.



▲ Figure 4, P-Band Image of rural area. Many of the line shaped features are cadastral boundaries.

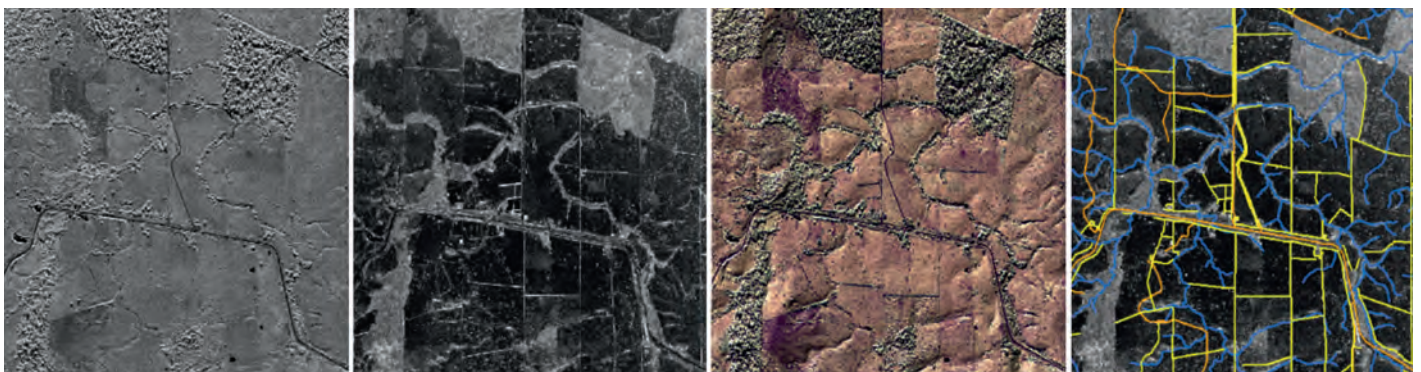
extracted features with actual cadastral boundaries. Those boundaries can be marked with a pen on top of the image. Back in office, the polygons for spatial units (parcels) can easily be identified and fed into the database with the required accuracy. ◀

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▲ Figure 5, Example of boundary extracting from radar imagery.

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EDUCATIONAL TOOLS FOR FIT-FOR-PURPOSE LAND ADMINISTRATION

Experiences and Lessons from Mozambique

In most countries, realising the continuum of land rights ideology and the fit-for-purpose land administration approach will require a suite of policy, legal, institutional and technical interventions. Another key component is capacity development; scaled implementation requires individuals, organisations and society as a whole to understand, support and apply the approach. The authors present recent experiences from Mozambique, where a training package based upon the fit-for-purpose mindset was developed, shared and tested in collaboration with local practitioners.

Mozambique has an ambitious plan to map five million land interests in the space of five years, the so-called Terra Segura programme. The fit-for-purpose approach is regarded as one way to achieve this goal, but widespread awareness and training programmes are needed. Whilst the fit-for-purpose philosophy and methods are reasonably well described, much less is documented with regards to appropriate training techniques. The collaborative development of a two-week training programme was undertaken by the Faculty of Geo-information Science and Earth Observation (ITC) of the University of Twente, The Netherlands, and the Netherlands' Cadastre, Land Registry and Mapping Agency (Kadaster) in coordination with the National Directorate of Lands (DINAT) of the Ministry of Land, Environment and Rural Development in Mozambique in order to start filling the gap. The programme has been made possible through the support of the Netherlands Fellowship Programmes (NFP).

AIM

The overarching aim for the package was to provide participants with field experience in using imagery as a basis for adjudicating and mapping land rights – in both urban and rural areas – and to teach them to consider the implications of the approach when implementing it at scale. Specifically, the aim for the participants was to be able to use satellite or aerial imagery to establish parcel index maps in selected rural and

urban sites and to discuss the advantages and disadvantages of image-based land adjudication and cadastral mapping.

MINDSET

Emphasis was on process and procedures, rather than specific technologies. The idea was that by focusing on the technical procedures, potential legal and institutional challenges would be brought to the fore. The latter are key in terms of successful

implementation and scalability. There were opportunities for self-reflection and group reflection at selected points in the exercise.

STUDY SITE

It was estimated that a suitable study area, for a group of approximately 24 participants working in groups of three, would be 8km². This would be easily divisible into two separate groups of four 1km x 1km quadrants. If more than eight groups were



3
6

DEFINIR OS ATRIBUTOS

ATRIBUTO	1	2	3	4	5	6	7	8	9
NOME COMPLETO	/	/	/	/	/	/	/	/	/
DATA NASCIMENTO	/	/			/	/	/	/	/
CÓDIGO DA PARCELA									
IDENTIFICAÇÃO	/	/	/	/	/	/	/	/	/
LOCALIZAÇÃO	/	/	/	/	/	/	/	/	/
GÊNERO		/	/	/	/	/	/	/	/
SUJEITO	/	/	/	/	/	/	/	/	/
PROTEÇÃO	/	/	/	/	/	/	/	/	/
ESTADO CIVIL	/	/	/	/	/	/	/	/	/
FINALIDADE	/	/	/	/	/	/	/	/	/
DIMENSÃO	/	/	/	/	/	/	/	/	/
CONTACTO	/	/	/	/	/	/	/	/	/
FORMA DE AQUISIÇÃO	/	/	/	/	/	/	/	/	/
CO-TITULARIDADE (Sim - Não)	/	/	/	/	/	/	/	/	/
SIGNATÁRIO									
TITULAÇÃO									
INFRAESTRUTURA	/	/	/	/	/	/	/	/	/
TERRAS BENTIVOIRAS									

to take part in the exercise, the number of 1km x 1km grid blocks could be scaled up. Both (peri-)urban and rural land use types were included; the former consisted of regular parcel shapes, whilst the latter was a pastoralist community.

MATERIALS

Imagery of the study location was required. Products from conventional aerial imagery flights, high-resolution satellite imagery, high-quality imagery captured from unmanned aerial vehicle (UAV) flights or even images captured from web mapping services could be used. Selection was based on fit-for-purpose thinking, with price and availability representing common constraints. The images were cloud free and, preferably, had a 60cm resolution (or better). However, this was not possible for one of the case areas. If possible, the images should be orthorectified and georeferenced, but this is not strictly essential for the fieldwork. Extracts representing a size of just over 1km x 1km in the field should be plotted on a 1:2,000 scale. The 1km x 1km quadrant should be represented with a red perimeter. The actual represented area on the paper plot is

bigger to allow drawing of boundaries that go beyond the printed area. The plots should be provided on high-quality paper, and paper notebooks (logbook), pens and high-quality markers are needed.

PREPARATORY WORK

Appropriate authorities and community leaders must be contacted in advance – and this was also the case in Mozambique. During these interactions, prior agreement should be reached on: the available working area; availability of land holders or community members to participate; how to inform land holders and community members about the purpose; and the date and time of the field exercise.

TEAM PREPARATIONS

Groups of three participants should be formed. Each group is allocated a 1km x 1km block as developed from the available imagery. Groups should study their allocated block and make rough estimates of the number of parcels included and the type of terrain involved. Each group should discuss with other groups about the parcels that overlap into neighbouring blocks to decide which group will do the overlapping plots, get agreement, etc. The participants prepare a list of attributes to be collected. These should relate to the specific rights and right holders being recorded. Each group should also develop a workflow they intend to follow for the adjudication and mapping of each parcel.

FIELDWORK

After travelling to the study location, the group(s) must first make acquaintance with local authorities and take part in the appropriate meet-and-greet ceremonies. Once the reconnaissance is complete and the group and the participating community have reached agreement on the process, data collection can commence. Data collection

involves conducting boundary adjudication activities in a systematic fashion – including sketching boundaries on the aerial imagery and recording accompanying attributes for each parcel (or property object) and accompanying right. Not all boundaries will be visible on the imagery. Such non-visible boundaries can be captured by simple field surveys. Monumentation is not included in the process; the image with drawn boundaries is the maximum available accuracy, but this may be improved later.

LINKING AND SHARING RESULTS

The owner or occupier of the spatial unit will receive a piece of paper showing the preliminary parcel identifier number of the spatial unit. This is taken to the trusted intermediary who is collecting the information about the nature of the right, the person(s) and the unique (preliminary) parcel identifier number. A link between all the information is made using simple yet standardised forms. A key element of the process is that the community receives tangible evidence of the process very close to the time when the activity is completed. The easiest artefact to reveal is the marked-up aerial imagery – complete with boundaries and owners identified. Ideally, a copy of this image is provided to the community.

IN THE OFFICE

Whilst a manual adjudication process can be completed well within a day for a 1km x 1km block (depending on information density), the confirmation of maps and certificates usually takes longer. In-office digital processes are needed: scanning and georeferencing of fieldwork, vectorising spatial data, digitising the attribute data related to database development, and certificate production. Ideally, a supportive mobile training and education vehicle would possess these tools.





LOOKING AHEAD

This approach was piloted in Mozambique and it was a great experience for the participants, all of whom were land professionals. The fieldwork exercise was very helpful in understanding fit-for-purpose thinking. It was based on locally available resources and expertise. Local stakeholders in the land sector such as Verde Azul Consultants and the NGO Community Land Initiative (iTC) played an important role. The training course contributed to further experimentation and the development of a fit-for-purpose approach for Mozambique's ambitious plan to map five million land parcels in five years. ◀

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EXPLORING THE NEEDS, OPTIONS AND FUTURE DEVELOPMENTS

Apps for Land Administration

The use of community participation, mobile technologies and cloud storage services could create a new way of undertaking land administration activities, and ultimately lead to more secure land rights for all. Sparked by these grand visions – which were first promoted by Robin McLaren amongst others in the late 2000s – alternative land administration platforms are now emerging, such as cadasta.org, landmapp.net and mobineo.org to name but a few. Apps lie at the heart of the developments...but what do we really mean by a 'land administration app' and what must such an app be capable of? Here, the authors provide a brief overview.

EXPONENTIAL UPTAKE

New-era land administration calls for approaches that are 'fit-for-purpose', 'pro-poor' and supportive of a 'continuum of land rights'. Deeper exploration of these concepts shows that mobile devices are ready-made support tools. In the hands of a responsible operator – and loaded with the right apps – information about people, rights and land can be created quickly. The technology, especially the so-called smartphone variety, is technically robust, computationally powerful, functionally flexible, relatively cheap and increasingly available and accessible to all – even to those often considered socially, politically or economically marginalised. These features

and characteristics will only further increase over time.

GUIDING PRINCIPLES

Pro-poor and fit-for-purpose criteria, respectively outlined by the Global Land Tool Network (GLTN) and the International Federation of Surveyors (FIG), can be used to provide guidance on the capabilities of an app for land administration. The pro-poor mindset demands affordability, transparency, accessibility, equitability, registration of all types of rights, and recording of secondary rights and complex rights. But it also requires simplicity, quick recording techniques, minimal costs, reproducibility and relevance. Less focus is placed on



spatial accuracy. Likewise, the fit-for-purpose approach demands affordability, reliability and inclusiveness. In addition, flexibility (in data capture approaches), attainability, participation and upgradability are necessary.

ESSENTIAL CRITERIA

The guiding principles can be converted into essential app criteria. Based on feedback from key informants from within the global land administration sector, from the perspectives of accessibility, availability, functions and technical features a land administration app should: be equally accessible amongst all the beneficiary groups; be affordable for those beneficiary groups; create the opportunity for recording varying tenure types (including customisable attributes); have the ability for the inclusion of different languages; have

3D GIS	ArcGIS	ArcPAD ESRI	Collector for ArcGIS	CyberTracer	DataPoint
Field Tracer	Fulcrum	GeoODK Collect	Geo-Wiki	GIS Kit	GIS Pro
GISRoam	GPSEssentials	IGIS	Integrity GIS	Locus Free	MapGo GIS Data Collection
MapIt-GPS Data Collector	MAST Application Suite	Mobile Data Collection	Mobile GIS (GIS2GO)	My maps	Open Tenure
Pocket Earth	Point GIS	SuperSurv (SuperGeo)	SuperSurv M3--GPS Plug-in	View Ranger	Wolf-GIS

▲ Table 1, Example Off-the-shelf and Made-to-order land administration apps.



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functionality for different land administration processes; require operators to have little to no programming skills; require operators to have little to no training; have extremely simple user interfaces; enable online and offline availability; have low-bandwidth requirements (for online); allow the opportunity to record multimedia content (particularly imagery); have openness to storing common and open-data formats (SHP,KML, CSC); allow for back-end cloud selection; allow for the provision of varying base layers (orthophotos, satellite imagery or free layers); have the ability to capture and work in local and global coordinate systems; allow data storage in local or remote databases; support standardised and custom-built data models; have the possibility to be installed on different operating systems; and have the ability for external device connectivity (e.g. higher-grade GNSS).

OFF-THE-SHELF

Taking the above into account, a considerable number of 'off-the-shelf' apps already exist: more than 30 different offerings (Table 1). These are capable of supporting parts of a land administration workflow, but are not designed specifically for it. The 'off-the-shelf' apps are usually generalised spatial data collection apps that are capable of data collection, storage, mapping, navigation and inheritance of different roles. They can collect coordinates, but also multimedia data including textual attributes, audio, imagery

and video. Examples include: 'Collector for ArcGIS', 'Locus Free Pro', 'MapIt-GPS Data Collector' and SuperGeo's 'SuperSurv' and 'GeoODK'.

FIT-FOR-PURPOSE?

Only a few of these have been tested for land administration, particularly in terms of functionality, processes, data quality and social acceptance. The November 2015 edition of GIM International previously reported on a simple yet successful pilot demonstration conducted using mobile devices, including Esri's 'Collector for ArcGIS', and linkage to Trimble R1s (for improving spatial accuracy) in Colombia. A similar trial has been run using the same app/tool combination, with apparent technical success, in the Amhara region of Ethiopia in 2015. Such investigations show that there are key differences and choices in terms of usability, extendibility, functionality, back-end support, costs (free vs. one-off vs. subscription), spatial accuracy and offline functionality. In short, some apps appear more ready to support land administration activities than others – although 'where' one wishes to undertake land administration work could have a significant bearing on choice. In addition, none are really designed for non-professional users and they all have limited customisation options.

MADE-TO-ORDER

More recently, apps (and/or supportive platforms) built specifically for land administration requirements have emerged: cadastra.org, mobineo.org, landmapp.net, FAO'S Open Tenure and USAID's 'MAST Application Suite' are just some examples. Often coming complete with significant donor backing, supportive organisational structures, back-end cloud capabilities and differing business models, these offerings seek to provide responsible end-to-end – or beneficiary-to-database (or certificate) – land administration support. The focus is particularly on contexts where land rights recording is incomplete, regarded as too time-consuming, lacks transparency or is in a state of decay. Some take a commercial approach, whilst others have a not-for-profit mindset. Although all are currently in the early stages of R&D or advanced piloting, scaled implementation is the end goal. Time will tell which business and technical arrangements are sustainable in the longer term.

FUTURE DEVELOPMENTS

With the growing mix of off-the-shelf and made-to-order land administration app offerings, the land sector and land professionals have an increasing number of options when undertaking the fit-for-purpose or pro-poor parts of their work. It can be assumed that these offerings are only going to improve in terms of adherence to the guiding principles and essential criteria. Whilst a very small snapshot of developments is provided here, it seems a GIM International 'apps for land administration' product survey, or Geo-matching.com equivalent, could provide a useful update on this highly dynamic and ever-growing part of the land sector. ◀

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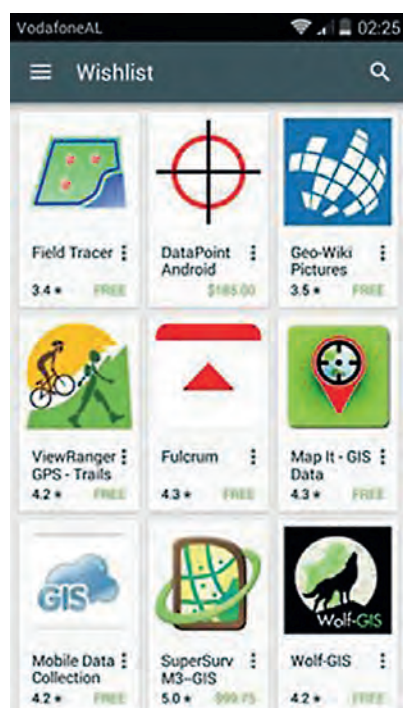
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- Crowdsourcing Support of Land Administration <http://bit.ly/29Kx9tB>



Geospatial Information Management Towards Good Land Governance

For the fourth time in the history of the United Nations Global Geospatial Information Management initiative (UN-GGIM), geo-spatial experts, interested parties and delegates from 57 Member States gathered to exchange information on the role of geospatial information in modern society. During this conference, the focus lay particularly on Good Land Governance. This UN-GGIM High Level Forum, held from 20-22 April in the UN Economic Commission for Africa Headquarters in Addis Ababa, Ethiopia, concluded with the adoption of the Addis Ababa Declaration.

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The UN-GGIM Committee of Experts gathers every year, mostly during the summer in the United Nations HQ in New York, and

every other year the committee invites the wider community of NGOs, governments, private sectors and other interested parties to hold discussions, exchange information and network together. There is always an overarching theme, and this year's theme was appropriately entitled "Geospatial Information Towards Good Land Governance for the 2030 Agenda". (The 2030 Agenda refers to the Sustainable Development Goals of the UN). It was appropriate, because it is precisely on the African continent, as in other developing parts of the world, that good land governance is often lacking. However, it needs to be in place in the future to ensure land rights for the population.

The forum was opened by Mulatu Teshome, President of Ethiopia, on April 20. President Teshome noted that 75% of people-to-land relationships globally have not been formalized. Informal relationships are paving

the way for insecurity of tenure and the unproductive use of land. Oliver Chinganya, Director of the African Centre for Statistics at the Economic Commission for Africa added that 'population growth and urbanization represent a challenge.' And 'countries need to comprehend the scale and usage of land. They need to understand critical land information for management, for coping with climate change and for ensuring land rights for citizens.'

Speakers at the conference encouraged the Member States to plan, coordinate and co-operate with other institutions and to share data and information in an open way, advocating at the same time coordination between mapping and geospatial agencies and national statistics institutions alike. This should result in integration of geospatial and statistical information. Several speakers expressed the wish to see partnerships arise between infrastructure development, geospatial applications, research, human capacity building, resource mobilization and institutional collaboration. The development of joint research initiatives into land governance between the African countries, together with scientific, technical and financial partners and possibly the support of Africans who have emigrated overseas, was seen as a way forward by André Nonguierma, from the



Economic Commission for Africa / African Centre for Statistics. Nonguierma stated that Africa should be self-reliant and 'develop indigenous African capabilities and initiatives where all the technical capacities are maintained and shared.'

The 300+ delegates at the High Level Forum emphasized the positive effect of geo-spatial information on meeting the sustainable development goals, but also the effectiveness of governance, decision and policy making. According to them, accurate geospatial information will underpin both the successful implementation of the goals and good land governance in the future.

At the end of the conference, the delegates adopted the Addis Ababa Declaration in which they declared that good land administration and management is a pillar of good governance and efficient government

and that the development of fit-for-purpose land administration and geospatial information should be supported by Member States. The Addis Ababa Declaration also contains the delegates' support of political decision makers regarding the importance of geospatial and land information in the context of the Sustainable Development Goals of the 2030 Agenda for Sustainable Development and the 2063 African Union Agenda. The delegates embraced open data and standards, innovative and creative approaches and platforms that are fit-for-purpose to collect and collate, share and distribute geospatial information. They also undertook to realize, measure and report progress and to document, record and recognize people-to-land relationships in all their forms globally, and to sustain partnerships and joint actions with UN entities, including UNECA, FAO, UN-Habitat/Global Land Tool Network and the World Bank.



UN-GGIM
UNITED NATIONS INITIATIVE ON
GLOBAL GEOSPATIAL
INFORMATION MANAGEMENT

During the conference, the hall of the UNECA venue was the place to be – especially during coffee and tea breaks - for delegates to update themselves on technology. A small exhibit showcased hardware and software from companies such as Hi-Target Surveying, Esri, Trimble and many more.

The UN-GGIM HLF in Addis Ababa was jointly organized by the Government of Ethiopia, the United Nations Global Geospatial Information Management (UN-GGIM) and the Economic Commission for Africa (ECA). ◀



IMAGINATION
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“A buddy
I rely on.”



RUIDE_  



FIG Publications

The FIG website provides a wealth of information and documentation on issues related to the work carried out by the FIG Commissions and on cooperation with other organisations – e.g. professional umbrella organisations, UN organisations, etc. The FIG publications highlight the developments in the survey profession.

The FIG publications are divided into four categories. FIG Policy Statements are prepared to explain FIG policies on important topics to politicians, government agencies and other decision makers, as well as surveyors and other professionals. FIG Guides deal with topical professional issues and provide guidance for the surveying profession and relevant partners. FIG Reports include valuable information on specific topics of relevance to the profession, members and individual surveyors. FIG Regulations include statutes, internal rules and work plans adopted by the FIG organisation. A new FIG Report has been published in this series: FIG Publication No 67 on Property Taxation for Developing Economies. This Report is authored by Prof Frances Plimmer and Prof William J McCluskey and has been prepared in close cooperation with the Global Land Tool Network (GLTN) and UN-Habitat. The publication discusses a practical and resource-led approach to implementing an

efficient and effective system of taxing real estate in order to raise funds to pay for much needed community services for the benefit of local inhabitants. The focus is on developing a system based on available resources, rather than a 'wish list', and recommends that the tax be paid by property occupiers (rather than owners) in the absence of a comprehensive land title register. Such a system can be both sustainable and scalable, and, with good governance together with the delivery of appropriate services, can enhance the quality of life and opportunities for improvement for communities.

The FIG website also provides the proceedings of the FIG events as Working Weeks and the FIG Congress.

Cadastral Template

The Cadastral Template is a generic template for country profiles describing the status of cadastre and land administration, and the need for improvements. The template facilitates benchmarking and the development of performance indicators. It is a web-based resource that gathers and authenticates information through an enabling platform. Data from about 50 countries has been already moved into the Cadastral Template - which can be updated by the authorised users.

OICRF

OICRF is the International Office for Cadastre and Land Records, one of the permanent bodies of the International Federation of Surveyors (FIG). OICRF serves as a documentation and study centre for land administration. OICRF maintains a digital library that contains almost 16,000 publications. OICRF contents are available in different languages.

Land Administration Domain Model

A special section on the Land Administration Domain Model was published in the Scientific Journal Land Use Policy, Volume 49, December 2015, p527-689. Land Use Policy is an international and interdisciplinary journal concerned with the social, economic, political, legal, physical and planning aspects of urban and rural land use. The special section in the December 2015 edition contains 16 scientific articles. The Land Administration Domain Model is developed by the International Organisation for Standardisation in very close cooperation with FIG.

More information

www.fig.net



15th Global Spatial Data Infrastructure World Conference Update



Readers of our previous columns and visitors to the GSDI Association website (gsdiassociation.org) will know that the 15th Global Spatial Data Infrastructure World Conference (GSDI 15) will take place in Taipei, Taiwan from 29 November to 2 December. The latest information and registration links are available from the official conference website at <http://gsdi15.org.tw>. GSDI 15 is being hosted by GSDI member Taiwan Association for Disaster Prevention Industry (TADPI) with substantial sponsorship support from the Ministry of Interior, government of Taiwan, Rep. of China.

The overall theme of the conference is 'Spatial Enablement in the Smart Homeland', focusing on three principal sectors – Smart Disaster Prevention, Smart Transportation and Smart Cities. As of mid-July, more than 150 abstracts had been accepted for presentation at the conference, and full papers, to be used in a post-conference peer-reviewed book, were due by end of July. All submissions will be available in a

digital Proceedings, that will also be available online.

There has been great interest in workshops, which will be presented throughout the conference, on a wide range of topics. More than 25 government agencies, research institutes and companies have now expressed interest in conducting workshops at the conference, which means plenty of learning opportunities across a wide range of subjects. The draft conference programme should be on the website by August, so please visit <http://gsdi15.org.tw> for more information.

Several Keynote speakers have been engaged, including:

- Prof Menno-Jan Kraak, President of the International Cartographic Association (ICA)
- Mark Reichardt, President and CEO of the Open Geospatial Consortium (OGC)
- Ed Parsons, Geotechnologist at Google, Inc.
- Dr Vernon Singhroy, Chief Scientist, Canada Centre for Remote Sensing, Natural Resources Canada

- Dr Dewayany Sutrisno, Senior Research Professor, Geomatics Research Center of the Indonesian National Geospatial Information Agency (BIG)
 - Prof Hidenori Tamagawa, Department of Urban System Science, Tokyo Metropolitan University, Japan
 - Dr Satoshi Sekiguchi, Director-General of the Division of Information Technology and Human Factors, Agency of Industrial Science and Technology (AIST), Japan
- Significant support for the conference is being provided by co-organisers Sinotech Engineering Consultants Inc., the GIS Research Center at Feng Chia University, and the Taiwan Group on Earth Observations (TGEO).



More information
www.gsdi.org



▲ The Taipei Nangang Conference Centre, venue for GSDI 15



Commission 3: Earth Rotation and Geodynamics

The Earth is evolving day by day and its surface and interior are continuously changing. Since we are living on the surface of such a restless planet, it is extremely important to understand the motion and dynamics of the Earth. Geodynamics is therefore the study of the deformation of the Earth. IAG Commission 3 plays a key role in promoting a study of the science of Earth rotation and geodynamics.

Monitoring Earth rotation is indispensable to our daily life, because it defines time and parameters essential to orbit determination. Rotation of the Earth is closely related to its internal structure. In the 17th century, Newton and Huygens proposed different models of the Earth's rotation, namely homogeneous Earth and concentrated mass, respectively. Since then various discoveries have been made, which has deepened our understanding of the Earth's structure. Deformation of the Earth is accompanied by the dissipation of heat inside the Earth. Heat

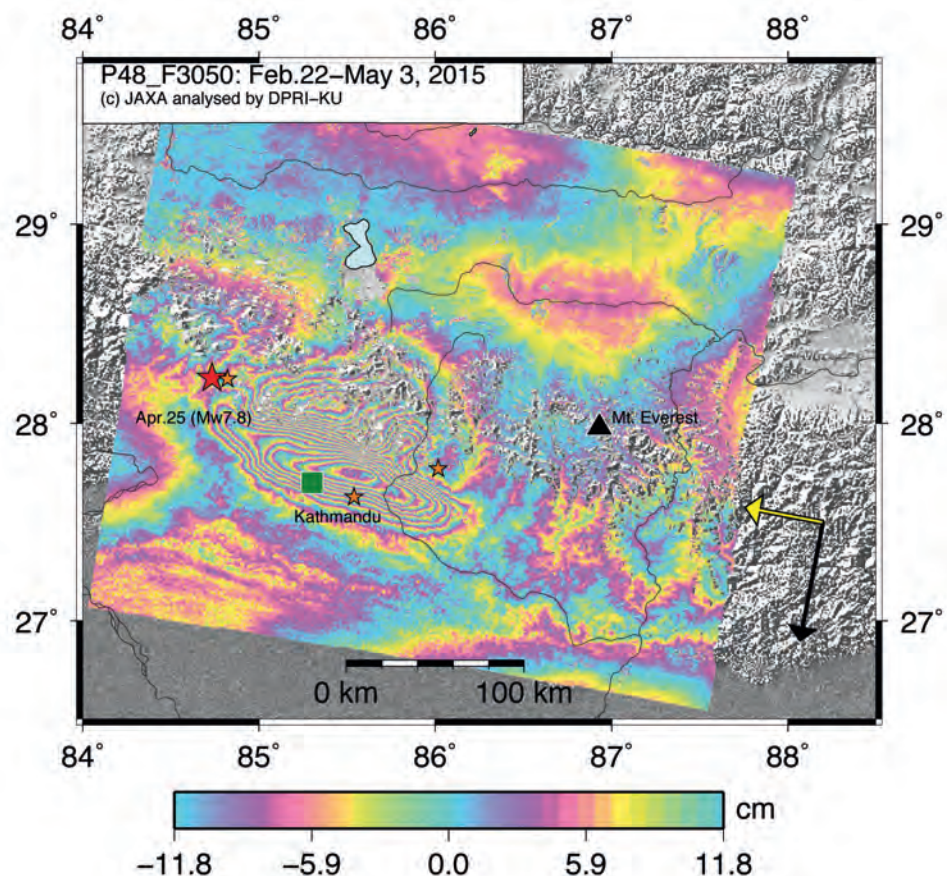
is transferred to the surface by mantle convection, which ultimately causes the motion of the tectonic plates. Tectonic plates move and collide with each other on the surface of the Earth. Monitoring of the movements of tectonic plates is essential to understanding mechanisms for the generation of earthquakes and other tectonic phenomena, and their related natural hazards. Recent earthquakes and volcanic eruptions have caused large deformations. Several geodetic techniques revealed associated deformation and help scientists understand their generation processes (see figure).

There are several other important factors that affect the Earth's deformation. The sun, moon and other planets cause the Earth to deform. The response of the ground to this is the Earth tide, which also provides invaluable information on the interior of the Earth. There is a considerable amount of fluid in and around the solid Earth; atmosphere, hydrosphere,

groundwater and the Earth's core. They too play key roles in the deformation process on a broad scale in space and time. The cryosphere is also an important region to be studied, especially from the viewpoint of monitoring of global warming. The melting of ice sheets causes deformation of the lithosphere with a long time constant. This is known as glacial isostatic adjustment (GIA), which also gives information of the structure of the upper mantle.

Thus, all the processes acting on the Earth are closely related to each other and are topics of interest to Commission 3. This commission works to develop cooperation and collaboration in computation, in theory and in the observation of Earth rotation and geodynamics.

More information
www.iag-aig.org



Next Year in Washington



The 28th International Cartographic Conference (www.icc2017.org) will be held from 2 to 7 July 2017 in Washington, D.C. The Local Organizing Committee (LOC) is now accepting submissions of abstracts and papers (icc2017.org/abstracts-full-papers-and-posters) – the deadline is 26 October, so all are encouraged to propose papers and actively participate in this major event. The themes of the conference, covering all aspects of cartography, are available at icc2017.org/conference-themes.

Washington, D.C. is one of the world's leading cities for cartography and geographic science innovation. Here, maps have a major impact on global policy. The World Bank, non-governmental agencies (NGOs), federal mapping organisations, and academic groups are using geographic tools to address the social challenges of our world.

This location also provides access to high-profile speakers that are leaders in the cartography and geographic information science disciplines. In addition, the LOC is arranging special events, including a map art display and historical map exhibits in association with the Library of Congress, which houses one of the world's largest map

collections. Tours will include organisations such as the US Geological Survey and the National Oceanic and Atmospheric Administration. The social programme will include events in the Washington, D.C. area, with several receptions, including a gala dinner on 6 July 2017. An orienteering competition will be held, as well as a meridian walk to visit the four points that served as the Prime Meridian for the United States before it adopted the Greenwich standard. The ICC 2017 venue is the Marriott Wardman Park Hotel, one of the largest and best-rated hotels in the area. The hotel's exhibit space will include the International Trade Exhibition, the International Cartographic Exhibition and the Children's Map Competition. In addition to traditional cartographic products, the International Cartographic Exhibition will include a display of aeronautical and nautical charts in association with the International Hydrographic Organization. Commercial companies, government and academic institutions, and NGOs are invited to reserve space in the International Trade Exhibition. Organisations can also sponsor individual events or items (icc2017.org/



[wp-content/uploads/2016/03/ICC2017Prospectus.pdf](#)).

The venue is located on the Washington, D.C. Metro Red Line at the Woodley Park/Zoo stop. Nearby is the National Zoo, home of four giant pandas, and with each attendee's complimentary pass, the metro gives access to all of Washington, D.C., including the free Smithsonian Museums and Washington's National Mall, with its historic monuments. The LOC is working with the US Department of State to facilitate the acquisition of visas as needed by ICC 2017 participants. The ICC 2017 LOC extends a warm invitation to everyone to participate in a magnificent conference and exhibition of cartography, in addition to a celebration of United States' independence on 4 July 2017.

More information
www.icaci.org

16 Years' Experience on the ISPRS Council (2000-2016)

Looking back, I have been able to carry out the priorities set at the beginning of my term. In 2000, when I was elected as Congress Director, my priority was to organise an excellent event that would be memorable in the minds of people for a long time and I can confess that I have achieved this goal, as I still meet many people around the world who thank me for the wonderful congress in 2004. Another interim goal that arose during my time as congress director was the request of young scientists to have their own programme at the congress, which resulted in the establishment of youth sessions and, after the congress, a summer

school for more than 80 students. This became a sustained tradition at many ISPRS events and congresses and led to the establishment of a student consortium. The path from Congress Director to Secretary General (2004-2008) was a very different one, but past experiences as manager at different governmental and private organisations made my task to fulfill my duties easy. Then came my term as the President of the Society (2008-2012). When I look back at the last days of my term as President, I realize that the priorities are reflected in the preamble of the Strategic Plan of the Society, which was approved in Vienna at the Centenary



▲ Orhan Altan

Celebrations of the ISPRS in 2010: "as the mission of ISPRS... to advance the

photogrammetry, remote sensing and spatial information sciences through international cooperation in research, development and education for the benefit of society and for environmental sustainability;... Implementation of the strategy will produce an efficient, professional organisation, ready to meet the challenges of changes to the environment...". In the Strategy Definition we say: "use core disciplines in applications such as disaster management, health, cultural heritage and maintenance of a sustainable environment" and "develop interest in key international issues such as working towards the Millennium Development Goals and climate change". We work closely with members of the Joint Board of Spatial Information Societies (JBGIS), the ICSU GeoUnions, UNOOSA, COPUOS, GEO and the UN initiative on Global Geospatial Information Management (GGIM). We have established especially close contacts with ICA, IAA, URSI and IUGG, among others; this is reflected in the

Scientific Programme of the Melbourne Congress. Within the ICSU GeoUnions, we work closely with related organisations on common projects. We have already completed 2 high class ICSU sponsored Projects; within GEO we worked in different bodies and have contributed to the Strategic Plan. In UNOOSA and COPUOS, we are one of the very active Societies and have finished a common project together with UNOOSA and JBGIS and published Best Practices Booklet on Disaster and Risk Management. Another common project was the publication on The Value of Geo-Information for Disaster and Risk Management (VALID). ISPRS organized, together with UNOOSA, a conference series on Space Technology Applications for Socio-Economic Benefits.

A major step, in the last years, was my election to the Executive Board of the International Council for Science (ICSU) at its 30th General Assembly, in 2011, in Rome and my reelection,

in 2014, in Auckland. I was nominated by the Geo-Union cluster of ICSU. It is the first time that an ISPRS officer has been elected as a member of ICSU Executive Board. ISPRS has become one of the leading international institutions in geospatial sciences. We have achieved this through the continued support of many people from different regions. On behalf of the ISPRS, I would like to thank them all for their continued support. I hope that they continue to participate in all the activities of the ISPRS as they have done in the past. At the end of my term I must say that the ISPRS Council was a good team, together with the Technical Commission Presidents, and I am confident that they will maintain this in the future.

Orhan Altan

More information
www.isprs.org

FUTURE EVENTS

AGENDA

► AUGUST

FOSS4G 2016

Bonn, Germany
from 24-26 August
For more information:
W: 2016.foss4g.org

► SEPTEMBER

GEOBIA

Enschede, The Netherlands
from 14-16 September
For more information:
W: www.geobia2016.com

2ND VIRTUAL GEOSCIENCE CONFERENCE

Bergen, Norway
from 22-23 September
For more information:
W: www.virtualoutcrop.com/vgc2016

INSPIRE CONFERENCE 2016

Barcelona, Spain
from 26-30 September
For more information:
W: <http://inspire.ec.europa.eu>

► OCTOBER

INTERGEO

Hamburg, Germany
from 11-13 October
For more information:
W: www.intergeo.de

3D CONFERENCE ATHENS

Athens, Greece
from 18-21 October
For more information:
W: <http://3dathens2016.gr>

TOPCART 2016

Toledo-Madrid, Spain
from 26-30 October
For more information:
W: www.topcart2016.com/

COMMERCIAL UAV EXPO

Las Vegas, Nevada, USA
from 31 October – 2 November
For more information:
W: www.expouav.com

► NOVEMBER

GLOBAL SPACE CONGRESS 2016

Abu Dhabi, United Arab Emirates
from 1-3 November
For more information:
W: <http://globalspacecongress.com>

TRIMBLE DIMENSIONS

Las Vegas, Nevada, USA
from 7-9 November
For more information:
W: www.trimbledimensions.com

CHINTERGEO

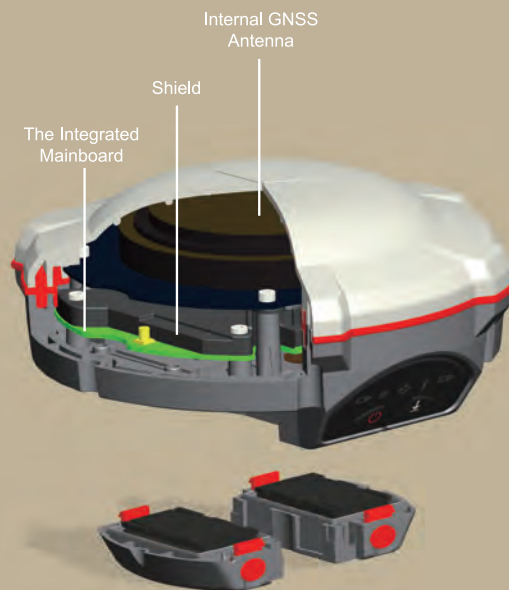
Suzhou, China,
from 24-26 November
For more information:
W: www.chintergeo.com

CALENDAR NOTICES

Please send notices at least 3 months before the event date to: Trea Fledderus, marketing assistant, email: trea.fledderus@geomares.nl

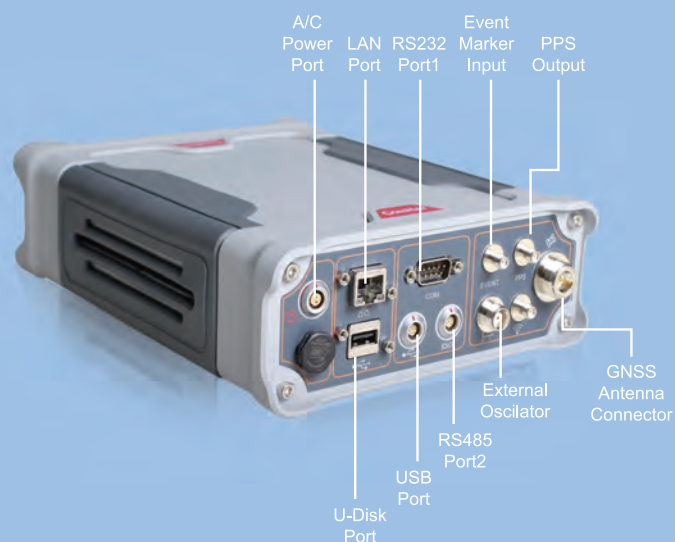
For extended information on the shows mentioned on this page, see our website: www.gim-international.com.

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INTERGEO 2016
October 11-13, 2016
Hamburg, Germany
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